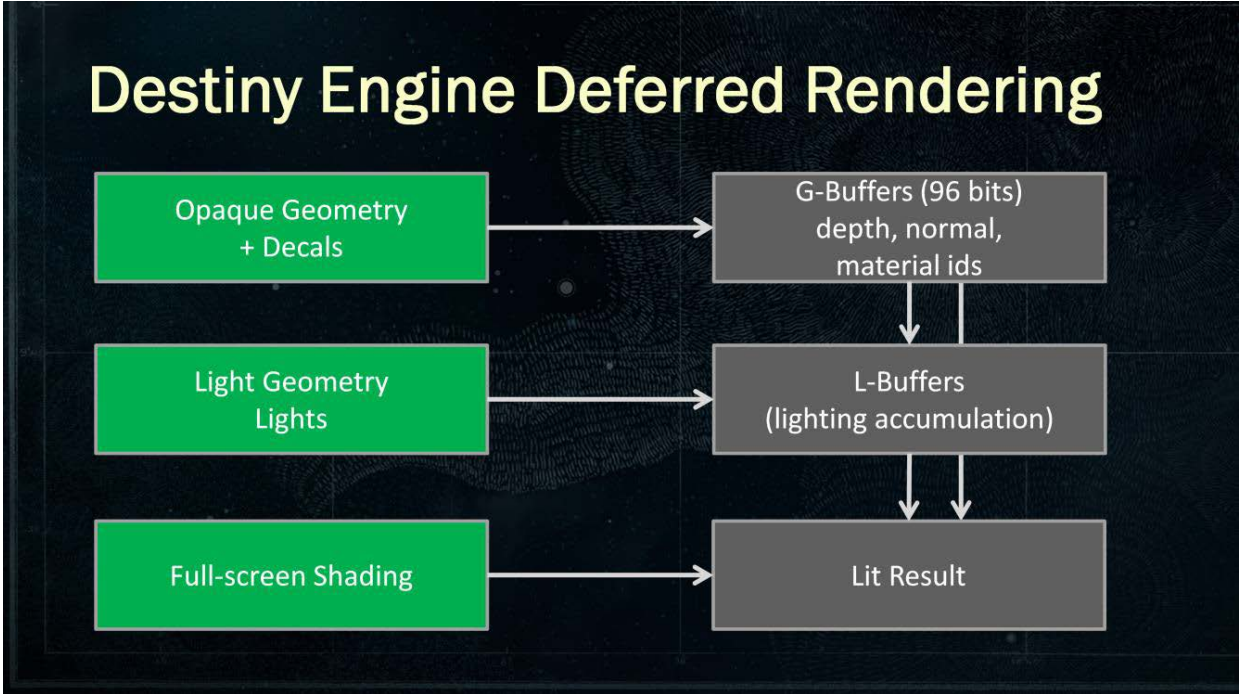


U.S. Patent No. 6,362,822

Tiger Engine

Activision
Exhibit 5

Claim 1

Claim 1	Tiger Engine
<p>[1.1] A shadow rendering method for use in a computer system, the method comprising the steps of:</p>	<p>The Tiger Engine (“Tiger”) (also called the “Destiny Engine”) is a cross-platform video game engine developed by Bungie, Inc. and used in video games published by Activision. Tiger utilizes rendering methods such as deferred shading/lighting and cascaded shadow maps for example, as shown below:</p>  <pre> graph LR A[Opaque Geometry + Decals] --> D[G-Buffers 96 bits
depth, normal,
material ids] B[Light Geometry
Lights] --> L[L-Buffers
lighting accumulation] C[Full-screen Shading] --> R[Lit Result] D --> L L --> R </pre> <p>http://advances.realtimerendering.com/s2013/Tatarchuk-Destiny-SIGGRAPH2013.pdf</p>
<p>[1.2] providing observer data of a simulated multi-dimensional scene;</p>	<p>Activision performs the step of “providing observer data of a simulated multi-dimensional scene.”</p>

Claim 1	Tiger Engine
	<p>The '822 specification teaches that, in one embodiment, observer data may include “observed color data and observed depth data associated with a plurality of modeled polygons within the scene as rendered from an observer’s perspective.” Col. 3:38-41.</p> <p>Observed color data includes, for example, “an observed red-green-blue value for the pixel(s),” and observed depth data includes, for example, “an observed z-buffer value for the pixel(s).” Col. 3:43-46.</p> <p>In the context of 3D graphics, a “camera” observes one or more objects in a simulated world. The camera captures a particular viewpoint of the world, observing specific data associated with the objects as seen from the camera’s point-of-view.</p> <p>Tiger’s deferred shading technique uses a geometry buffer (GBuffer) that stores material and object attributes as shown, for example, below:</p>

Claim 1

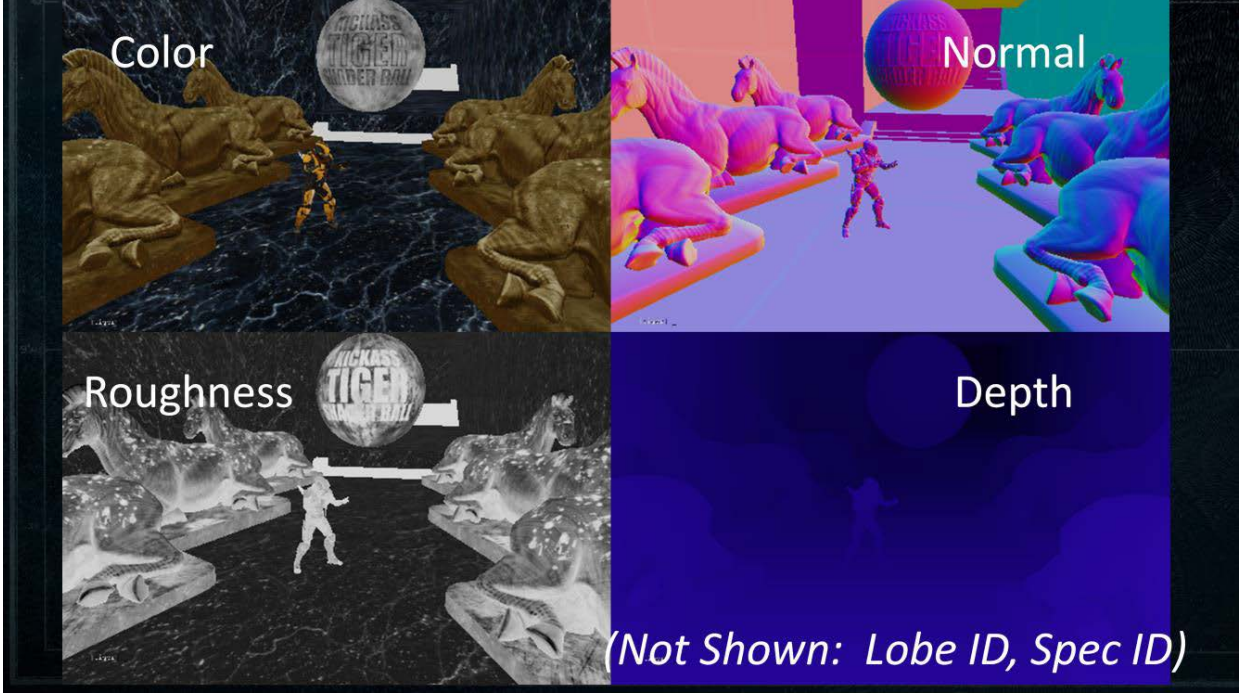
Tiger Engine

Destiny G-Buffers

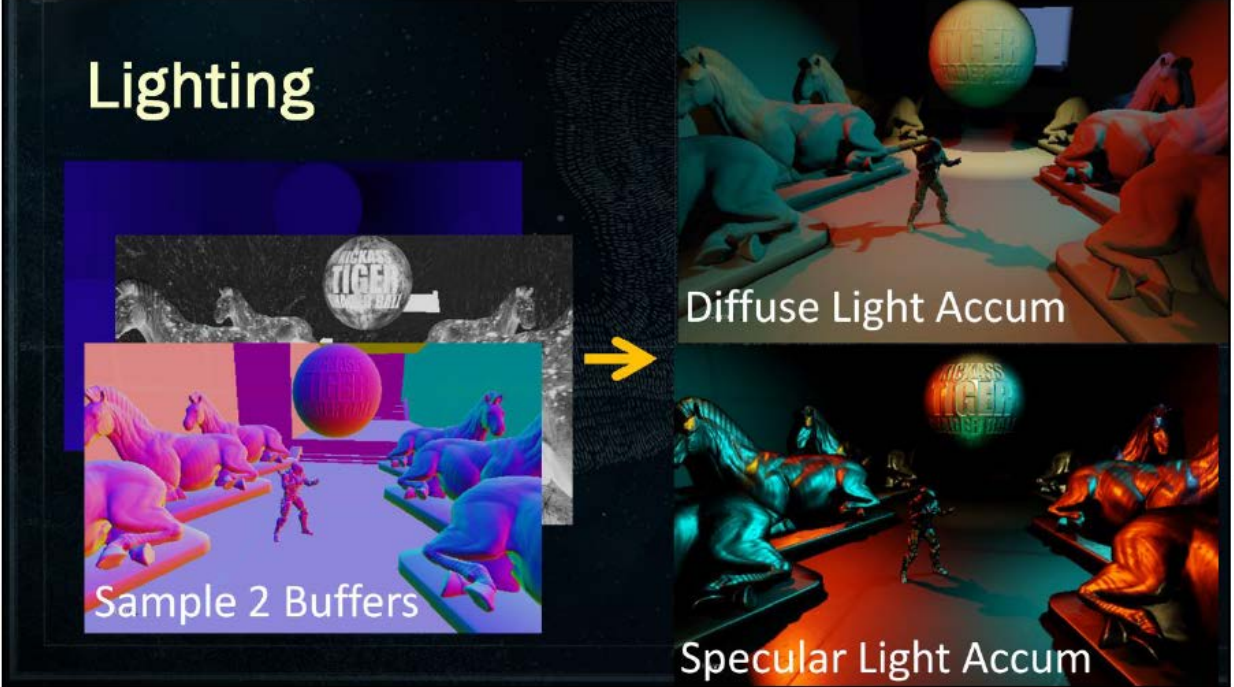
8	8	8	8
Albedo Color RGB			Ambient Occlusion
Normal XYZ * (Biased Specular Smoothness)			Material ID
Depth			Stencil

- **96 bits/pixel**
 - Up to 1200x720 resolution on XBOX 360, no EDRAM tiling

<http://advances.realtimerendering.com/s2013/Tatarchuk-Destiny-SIGGRAPH2013.pdf>

Claim 1	Tiger Engine
	 <p>The image displays four panels of a rendered scene from the Tiger Engine, illustrating different GBuffer (Geometry Buffer) outputs. The scene features a character standing on a platform with large, stylized horse statues and a spherical object in the background. The panels are labeled as follows:</p> <ul style="list-style-type: none"> Color: Shows the standard color rendering of the scene. Normal: Shows the surface normals of the objects, represented by a color gradient. Roughness: Shows the roughness of the surfaces, with darker areas indicating smoother materials and lighter areas indicating rougher materials. Depth: Shows the depth of the scene, with darker areas representing objects further from the camera. <p>(Not Shown: Lobe ID, Spec ID)</p> <p>http://advances.realtimerendering.com/s2013/Tatarchuk-Destiny-SIGGRAPH2013.pdf</p> <p>The geometry buffers (“GBuffer”) contain “observer data” described in the spec of the ’822 Patent such as “rgb” or red, blue, and green values for the given rendered scene (i.e. “Albedo Color RGB” as illustrated above), including further details such as the shape and surface material of objects rendered in the scene. For example, as illustrated above, the GBuffer can contain observed color data such as the rendered objects, color, shape, and material characteristics i.e. how rough or “shiny” an object may appear based on the material it is “made” from. Thus, Tiger provides observed color data. Also, as shown above the Tiger GBuffer includes depth data.</p>




Claim 1	Tiger Engine
[1.3] providing lighting data associated with a plurality of simulated light sources arranged to illuminate said scene, said lighting data including light image data;	<p>Activision performs the step of “providing lighting data associated with a plurality of simulated light sources arranged to illuminate said scene, said lighting data including light image data.”</p> <p>“Light image 51C includes RGB pixel data values for the light emitted, for X by Y number of pixels. For example, the data in light image 51C can represent the intensity, color, and/or pattern of light emitted by light source #1.” Col. 7:15-19.</p> <p>On information and belief, Tiger provides “lighting data... including light image data” such as, for example, when Tiger “render[s] light geometry” as shown below:</p>


Claim 1	Tiger Engine
	 <p>The we calculate lighting by rendering light geometry, and accumulating into diffuse and specular light accumulation buffers.</p> <p>Note that because of the way we packed the g-buffers, we only have to sample two of the g-buffer textures to get all the parameters needed for lighting:</p> <p>(depth, normal + spec lobe shape)</p> <p>http://advances.realtimerendering.com/s2013/Tatarchuk-Destiny-SIGGRAPH2013.pdf</p>
[1.4] for each of said plurality of light sources, comparing at least a portion of said observer data with at	On information and belief, “for each of said plurality of light sources,” Activision performs the step of “comparing at least a portion of said observer data with at least a portion of said lighting data to determine if a modeled point within said scene is illuminated by said light source and

Claim 1	Tiger Engine
<p>least a portion of said lighting data to determine if a modeled point within said scene is illuminated by said light source and storing at least a portion of said light image data associated with said point and said light source in a light accumulation buffer; and then</p>	<p>storing at least a portion of said light image data associated with said point and said light source in a light accumulation buffer.”</p> <p>Upon information and belief, Tiger iterates through each light source to determine whether a modeled point is illuminated by, for example, intersecting light sources with portions of the screen to be rendered. This intersection process involves comparing the observed depth data with the lighting depth data. As shown below, for example, the Tiger “calculate[s] light by rendering light geometry, and accumulating into diffuse and specular light accumulation buffers.” As shown below, “depth” is specifically listed as one of the “parameters needed for lighting,” further confirming that Tiger utilizes a depth test to determine which points within a scene are illuminated. Plaintiffs expect that analysis of the Tiger source code will confirm this functionality.</p>

Claim 1	Tiger Engine
	<div data-bbox="676 238 1900 922"></div> <p data-bbox="758 980 1793 1049">The we calculate lighting by rendering light geometry, and accumulating into diffuse and specular light accumulation buffers.</p> <p data-bbox="758 1092 1793 1161">Note that because of the way we packed the g-buffers, we only have to sample two of the g-buffer textures to get all the parameters needed for lighting:</p> <p data-bbox="758 1205 1178 1234">(depth, normal + spec lobe shape)</p> <p data-bbox="676 1278 1793 1307">http://advances.realtimerendering.com/s2013/Tatarchuk-Destiny-SIGGRAPH2013.pdf</p>

Claim 1	Tiger Engine
<p>[1.5] combining at least a portion of said light accumulation buffer with said observer data; and</p>	<p>Activision performs the step of “combining at least a portion of said light accumulation buffer with said observer data.”</p> <p>As shown below, for example, Tiger combines the accumulated diffuse light with the observed diffuse color:</p> <div data-bbox="674 414 1906 1104"> </div> <p>http://advances.realtimerendering.com/s2013/Tatarchuk-Destiny-SIGGRAPH2013.pdf</p> <p>Furthermore, as shown below, for example, Tiger combines the accumulated specular light with observed specular color:</p>

Claim 1	Tiger Engine
	<div data-bbox="678 232 1908 922"><div data-bbox="785 232 1205 280">Specular Light Accum</div><div data-bbox="779 289 1241 548"></div><div data-bbox="970 557 1033 621">*</div><div data-bbox="779 630 1241 881"></div><div data-bbox="785 881 1073 922">Specular Color</div><div data-bbox="1373 289 1835 354">Shading</div><div data-bbox="1373 410 1717 459">Specular Lighting</div><div data-bbox="1367 492 1829 743"></div></div> <p data-bbox="678 930 1787 963">http://advances.realtimerendering.com/s2013/Tatarchuk-Destiny-SIGGRAPH2013.pdf</p> <p data-bbox="678 1003 1908 1066">As shown below, for example, Tiger adds the diffuse and specular lighting to produce the “Lit Result”:</p>

Claim 1	Tiger Engine
	 <p data-bbox="762 987 1749 1019">And the finally the diffuse and specular lighting are added to get the final result.</p> <p data-bbox="674 1040 1782 1073">http://advances.realtimerendering.com/s2013/Tatarchuk-Destiny-SIGGRAPH2013.pdf</p> <p data-bbox="674 1114 1911 1255">Because of the distributive property of multiplication over addition, for example, $(2+2+2)*4 = ((2*4)+(2*4)+(2*4)) = 24$. Therefore, accumulating the combined diffuse light and diffuse color and the combined specular light and specular color yields the same result as accumulating the diffuse light and specular light and then combining with the diffuse color and specular color.</p>
[1.6] displaying resulting image data to a computer screen.	On information and belief, Activision performs the step of “displaying resulting image data to a computer screen,” such as, for example, when testing video games running the Tiger Engine such as Destiny and Destiny 2.

Claim 1	Tiger Engine
	As shown above, for example, Tiger displays resulting image data (i.e. the “Lit Result”) to a computer screen.